L Number	Hits	Search Text	DB	Time stamp
1	904	347/40-42.ccls.	USPAT	2003/08/22 13:12
2	19	347/40-42.ccls. and minimum near5 (distance or spacing) near5 (channel or nozzle or electrode or resistor or heater or port)	USPAT	2003/08/22 13:18
3	14036	347/1-109.ccls.	USPAT	2003/08/22 13:18
4	87	347/1-109.ccls. and minimum near5 (distance or spacing) near5 (channel or nozzle or electrode or resistor or heater or port)	USPAT	2003/08/22 13:19
5	14	347/1-109.ccls. and minimum near5 (distance or spacing) near5 (channel or nozzle or electrode or resistor or heater or port) same (mu.m or micron or micrometer or mm)	USPAT	2003/08/22 13:24
6	433	347/1-109.ccls. and (distance or spacing) near5 (channel or nozzle or electrode or resistor or heater or port) near5 (mu.m or micron or micrometer or mm)	USPAT	2003/08/22 13:59
7	142	(347/1-109.ccls. and (distance or spacing) near5 (channel or nozzle or electrode or resistor or heater or port) near5 (mu.m or micron or micrometer or mm)) and (interfer$ or crosstalk$)	USPAT	2003/08/22 13:25
8	4	347/1-109.ccls. and (distance or spacing) near5 (channel or nozzle or electrode or resistor or heater or port) near5 (mu.m or micron or micrometer or mm) same (interfer$ or crosstalk$)	USPAT	2003/08/22 13:26
9	1146	(distance or spacing) near5 (channel or nozzle or electrode or resistor or heater or port) near5 (mu.m or micron or micrometer or mm)	EPO; JPO; DERWENT	2003/08/22 14:02
10	16	((distance or spacing) near5 (channel or nozzle or electrode or resistor or heater or port) near5 (mu.m or micron or micrometer or mm)) and ink near1 jet	EPO; JPO; DERWENT	2003/08/22 14:00
11	438	minimum near5 (distance or spacing) near5 (channel or nozzle or electrode or resistor or heater or port)	EPO; JPO; DERWENT	2003/08/22 14:03
12	5	(minimum near5 (distance or spacing) near5 (channel or nozzle or electrode or resistor or heater or port)) and ink near1 jet	EPO; JPO; DERWENT	2003/08/22 14:02
13	278	(crosstalk$ or interfer$) same (distance or spacing) near5 (channel or nozzle or electrode or resistor or heater or port)	EPO; JPO; DERWENT	2003/08/22 14:04
14	5	((crosstalk$ or interfer$) same (distance or spacing) near5 (channel or nozzle or electrode or resistor or heater or port)) and ink near1 jet	EPO; JPO; DERWENT	2003/08/22 14:04

US-PAT-NO: 4166277

DOCUMENT-IDENTIFIER: US 4166277 A

TITLE: Electrostatic ink ejection printing head

---------- KWIC ---------

Detailed Description Text - DETX (6):
FIG. 4 illustrates one pattern of electrodes 17 for a printing head as in FIG. 3. In the particular example, by alternating the electrodes to extend on either side of the holes--the position of which are indicated by dotted outline at 11--they can be tapered to provide wider contact areas at 31 without being closely spaced to an extent which makes fabrication difficult. A minimum distance between electrodes of the order of 250 .mu.m is desirable to avoid air break-down at 2000 volts, but this distance can be reduced by surrounding the electrodes with a stronger dielectric, as in FIG. 3.

Current US Original Classification - CCOR (1):
347/55

Current US Cross Reference Classification - CCXR (2):
347/47

US-PAT-NO: 4593296

DOCUMENT-IDENTIFIER: US 4593296 A

TITLE: Ink jet printer with gas evacuating arrangement

---------- KWIC ---------

Brief Summary Text - BSTX (17):
Preferably the rows or columns of nozzles are located at a distance of about 1.27 mm from each other while the spacing between the holes in each row is about 0.4 mm.

Detailed Description Text - DETX (29):
The nozzles 19, which are intended to project ink sprays towards the surface S, forming printing dots on the said surface, are arranged in an array comprising two parallel rows, each of four nozzles, spaced apart by a distance of about 1.27 mm.

Detailed Description Text - DETX (30):
Each row comprises four nozzles spaced apart at equal intervals of about 0.8 m. The nozzles in the two rows are staggered relative to each other by a distance of about 0.4 mm, that is to say, a distance equal to half the distance between the nozzles 19 in each row.

Detailed Description Text - DETX (57):
The insulating layer 25 has, so to speak, the effect of increasing the distance in air which separates two adjacent nozzles, reducing the interference or "crosstalk" occuring between them in operation as a result of the limited

distance between the metal coatings 20.

Detailed Description Text - DETX (67):
As a further direct measure for minimising the electromagnetic interference between the operating circuits for adjacent nozzles, the cables of the strap 24 and possibly also the cables 22 which extend from the connector 23 to the element 17 are arranged in a linear array in which, for each pair of cables 22 connected to "hot" metal coatings 20 there is a neutral cable 22a connected to the electrical earth of the printer.

Claims Text - CLTX (12):
9. Printer as defined in claim 8, wherein the rows are spaced apart by a distance of substantially 1.27 mm while the said distance between the nozzles in each row is substantially 0.4 mm.

Current US Original Classification - CCOR (1):
347/55

Current US Cross Reference Classification - CCXR (1):
347/43

Current US Cross Reference Classification - CCXR (2):
347/45

Current US Cross Reference Classification - CCXR (3):
347/87

Current US Cross Reference Classification - CCXR (4):
347/92

US-PAT-NO: 5790149

DOCUMENT-IDENTIFIER: US 5790149 A

TITLE: Ink jet recording head

---------- KWIC ---------

Abstract Text - ABTX (1):

In an ink jet type recording head, nozzles 190 to 197 for jetting droplets of ink are arranged in such a manner that these nozzles are located along two line segments L1 and L2 which are inclined mutually in opposite directions with respect to a main scanning direction, and the two line segments constitute a substantially V-shape, so that problems such as a printing quality deterioration phenomenon and ink chamber interference can be solved, and higher printing qualities can be realized at high printing density.

Brief Summary Text - BSTX (7):

To realize high density recording by the ink jet type recording head described in JP-A-4-312859, the pitch between respective nozzles must be narrowed, namely the angle .alpha. should be made small. However, this angle setting is essentially restricted in order to prevent an occurrence of crosstalk or the like, which is caused by interference among the ink chambers at the bending portions of the slanted straight lines. Also, since this recording head is constructed so as to have a plurality of bending portions, the permeative depths in ink are different from each other between the recorded image at the bending portions and the recorded image at the peripheral

portions. Thus, as illustrated in FIG. 13, a plurality of fluctuations are produced in the entire recorded image.

Detailed Description Text - DETX (11):
Moreover, in accordance with this embodiment, the shape of the ink chamber positioned near the nozzle is made not by a curved surface with a constant radius, but by a curved surface having a smaller radius at the portion nearer to the nozzle, so that the distance between the nozzles located adjacent to each other is increased. Thus, interference such as crosstalk is more surely avoided, and better bubble exhausting characteristics are achieved since the radius of the curved surface is progressively decreased approaching the end of the nozzle.

Detailed Description Text - DETX (12):
In this embodiment, the minimum distance (d5=352.8 micrometers) between nozzles 191 and 194 is larger than a total value (d6=r1+r2=200 micrometers) of a distance (r1=100 micrometers) between the center of the nozzle 191 and an outer periphery of the ink chamber 171, and also a distance (r2=100 micrometers) between the center of the nozzle 194 and an outer periphery of the ink chamber 174, so that r3 can be made wide, i.e., larger than 100 micrometers, and so that the wall between the ink chambers can be made rigid.

Detailed Description Text - DETX (20):
One preferable example of the structure of an ink jet type recording head according to the present invention is shown in FIG. 11. This is known as a stacked type ink jet type recording head. In this recording head, stacked flow path ports in the flow path from an ink chamber 17 to a

nozzle 2 can be gradually shifted with ease. As a result, since the position of the nozzle 2 may be shifted outside the ink chamber rather than at the edge portion of the ink chamber 17, the location of the ink chamber can be lowered as compared with that of the nozzle. When this structure is employed in the V-shaped nozzle arrangement of the present invention, the distances between the adjacent ink chambers can be made sufficiently large. Thus, crosstalk is sufficiently prevented, and the distances between the nozzles can be shortened. It is therefore possible to arrange the nozzles at a high density. In FIG. 11, the ink is supplied from a common ink chamber 11 to the ink chamber 17, and then is jetted from the nozzle 2 via the flow path by pressuring vibrating plates 19 stacked on the ink chamber 17 by way of a piezoelectric element 20.

Current US Original Classification - CCOR (1):
347/40

Current US Cross Reference Classification - CCXR (1):
347/65

US-PAT-NO: 5923346

DOCUMENT-IDENTIFIER: US 5923346 A

TITLE: Shadow pulse compensation of an ink jet printer

---------- KWIC ---------

Abstract Text - ABTX (1):
In an electrostatic ink jet printer, all nozzles of a printhead are spaced generally the same distance from a moving paper print substrate. Three voltage levels are selectively applied to each nozzle of the printhead. As the paper moves past the printhead, a bias voltage Vb is applied to all nozzles which have a static protruding meniscus which shape is determined by a balance between the internal pressure, surface tension, and bias voltage. When the paper arrives at a print row, nonprinting nozzles have a shadow voltage pulse Vs, the "shadow pulse," applied thereto, and printing nozzles have a higher magnitude print pulse Vp applied thereto. The magnitude of the shadow pulse Vs causes an additional excursion of the ink meniscus to form at each non-printing nozzle. The higher magnitude of print pulse Vp causes an ink filament to move from a printing nozzle to the paper. The time duration of each print pulse is varied in accordance with an ink density parameter up to a range that is determined by the duration of the shadow pulse. The electrostatic field difference between nonprinting and printing nozzles (Vp-Vs) is of a low magnitude that inhibits ink filament deflection and ink volume differences due to crosstalk between nozzles.

Brief Summary Text - BSTX (9):

A typical magnitude for voltage Vb for practical nozzle separation distance of about 1 mm is about 800 to about 1,200 V DC above the ground potential of plate 17. For voltage Vp, a typical magnitude is about 450 to about 800 V DC above the magnitude of voltage Vb.

Brief Summary Text - BSTX (13):

It is also observed that when a print pulse is applied to only nozzles 10, 11 and 14, for example, all three ink filaments are deflected, the ink filaments from nozzle 10 deflecting due to bias and print voltage applied to nozzle 11, and the ink filament from nozzle 14 deflecting outward as above described, as the ink filament from nozzle 11 is deflected toward non-printing nozzle 12. However, if in this situation, nozzle 12 also becomes a printing nozzle, then the ink filament that issues from nozzles 11 will not be deflected, and the ink filament that issues from nozzle 12 will be deflected. However, if in this same situation, nozzle 13 also becomes a printing nozzle, then the three ink filaments that issue from nozzles 11, 12 and 13 are not substantially deflected, but the outward deflection of the ink filaments from nozzle 10 and 14 is more pronounced due to the combination of edge effects and crosstalk.

Brief Summary Text - BSTX (14):

The ink filament "crosstalk" effect is a function of electrostatic field interaction due to differences in applied voltages and, more specifically, the difference in the electrostatic field that is experienced by an ink filament nucleation site when the site is acting alone, versus the electrostatic field

that this nucleation site experiences when a jetting, or print voltage Vp, is applied to one or more of its neighbor nucleation sites, or when this nucleation site has no neighbor on one or more sides. The greater the difference between the acting-alone electrostatic field and the acting-together electrostatic field, the more pronounced will be the ink filament deflection effects and ink volume differences due to crosstalk.

Brief Summary Text - BSTX (19):

In this manner, the difference in the electrostatic fields between printing and non-printing ink filament nucleation sites is appreciably reduced, and the crosstalk ink volume differences and the crosstalk deflection of ink filaments moving from the printhead to the paper is substantially eliminated.

Detailed Description Text - DETX (4):

In this manner, the difference in the electrostatic fields among printing and non-printing ink filament nucleation sites is appreciably reduced, and the crosstalk ink volume differences and the crosstalk deflection of ink filaments moving from the printhead to the paper is substantially reduced.

Detailed Description Text - DETX (20):

The FIG. 5, 6 printhead provides a construction and arrangement whereby short tubular nozzles 10-14 are formed so as to protrude downward from a printed circuit board 80 toward paper 15 which overlies grounded metal plate 17. A supply of printing ink 81 is contained in a reservoir 82. Tubular nozzles 10-14 extend generally parallel to each other, and normal to the plane of paper 15 and plate 17. An exemplary spacing 83 of the nozzles from paper 15

is about 1 mm. An exemplary center-to-center spacing 84 of adjacent nozzles is
about 1 mm. An exemplary inner diameter 88 in FIG. 4 of nozzles 10-14 is about
150 micrometer, and an exemplary outer diameter 89 in FIG. 6 of nozzles 10-14
is about 200 micrometer.

Current US Original Classification - CCOR (1):
347/11

Current US Cross Reference Classification - CCXR (1):
347/10

Current US Cross Reference Classification - CCXR (2):
347/12

Current US Cross Reference Classification - CCXR (3):
347/15

Current US Cross Reference Classification - CCXR (4):
347/55

L Number	Hits	Search Text	DB	Time stamp
1	28273	347/$.ccls.	USPAT; US-PGPUB	2003/08/22 10:15
2	1	347/$.ccls. and ("100" or "125" or "150") near5 dpi same (crosstalk$ or interference)	USPAT; US-PGPUB	2003/08/22 10:16
3	72	347/$.ccls. and dpi same (crosstalk$ or interference)	USPAT; US-PGPUB	2003/08/22 10:23
4	31	347/$.ccls. and ("169" or "170") same (crosstalk$ or interference)	USPAT; US-PGPUB	2003/08/22 10:38
5	134	347/$.ccls. and ("169" or "170") near5 (mu.m or micron or micrometer)	USPAT; US-PGPUB	2003/08/22 10:26
6	211	347/$.ccls. and (electrode or spacing or distance) near7 (crosstalk$ or interference)	USPAT; US-PGPUB	2003/08/22 10:38
7	303	347/$.ccls. and (electrode or spacing or distance) near7 (crosstalk$ or interfer$)	USPAT; US-PGPUB	2003/08/22 10:39
8	3	347/$.ccls. and (electrode or spacing or distance) near7 (crosstalk$ or interfer$) near7 (dpi or mu.m or micron or micrometer)	USPAT; US-PGPUB	2003/08/22 10:40
9	13	347/$.ccls. and (electrode or spacing or distance) near10 (crosstalk$ or interfer$) near10 (dpi or mu.m or micron or micrometer)	USPAT; US-PGPUB	2003/08/22 10:41
10	6	347/$.ccls. and (electrode or channel) same (crosstalk$ or interfer$) near10 (dpi or mu.m or micron or micrometer)	USPAT; US-PGPUB	2003/08/22 10:42
11	109	347/$.ccls. and (electrode or channel) same (crosstalk$ or interfer$) same (dpi or mu.m or micron or micrometer)	USPAT; US-PGPUB	2003/08/22 11:25
12	1735	347/$.ccls. and (electrode or channel) near5 (spacing or distance)	USPAT; US-PGPUB	2003/08/22 10:54
13	968	(347/$.ccls. and (electrode or channel) near5 (spacing or distance)) and ink near1 jet	USPAT; US-PGPUB	2003/08/22 10:54
14	767	(347/$.ccls. and (electrode or channel) near5 (spacing or distance)) not ((347/$.ccls. and (electrode or channel) near5 (spacing or distance)) and ink near1 jet)	USPAT; US-PGPUB	2003/08/22 10:54
15	968	(347/$.ccls. and (electrode or channel) near5 (spacing or distance)) not ((347/$.ccls. and (electrode or channel) near5 (spacing or distance)) not ((347/$.ccls. and (electrode or channel) near5 (spacing or distance)) and ink near1 jet))	USPAT; US-PGPUB	2003/08/22 10:54
16	16	((347/$.ccls. and (electrode or channel) near5 (spacing or distance)) not ((347/$.ccls. and (electrode or channel) near5 (spacing or distance)) not ((347/$.ccls. and (electrode or channel) near5 (spacing or distance)) and ink near1 jet))) and (electrode or channel) near5 (spacing or distance) same (crosstalk$ or interfer$)	USPAT; US-PGPUB	2003/08/22 11:13
17	0	((347/$.ccls. and (electrode or channel) near5 (spacing or distance)) not ((347/$.ccls. and (electrode or channel) near5 (spacing or distance)) not ((347/$.ccls. and (electrode or channel) near5 (spacing or distance)) and ink near1 jet))) and (electrode or channel) near5 (spacing or distance) near5 (mu.m or micron or micrometer) same (crosstalk$ or interfer$)	USPAT; US-PGPUB	2003/08/22 11:14

18	115	((347/$.ccls. and (electrode or channel) near5 (spacing or distance)) not ((347/$.ccls. and (electrode or channel) near5 (spacing or distance)) not ((347/$.ccls. and (electrode or channel) near5 (spacing or distance)) and ink near1 jet))) and (electrode or channel) near5 (spacing or distance) near5 (mu.m or micron or micrometer)	USPAT; US-PGPUB	2003/08/22 11:14
19	33	(((347/$.ccls. and (electrode or channel) near5 (spacing or distance)) not ((347/$.ccls. and (electrode or channel) near5 (spacing or distance)) not ((347/$.ccls. and (electrode or channel) near5 (spacing or distance)) and ink near1 jet))) and (electrode or channel) near5 (spacing or distance) near5 (mu.m or micron or micrometer)) and (crosstalk$ or interfer$)	USPAT; US-PGPUB	2003/08/22 11:15
20	216	347/$.ccls. and (electrode or channel) near4 (crosstalk$ or interfer$)	USPAT; US-PGPUB	2003/08/22 11:26
21	143	(347/$.ccls. and (electrode or channel) near4 (crosstalk$ or interfer$)) and ink near1 jet	USPAT; US-PGPUB	2003/08/22 11:26
22	92	347/$.ccls. and (electrode or channel) near4 crosstalk$	USPAT; US-PGPUB	2003/08/22 11:26
23	63	(347/$.ccls. and (electrode or channel) near4 crosstalk$) and ink near1 jet	USPAT; US-PGPUB	2003/08/22 11:27
24	29	(347/$.ccls. and (electrode or channel) near4 crosstalk$) not ((347/$.ccls. and (electrode or channel) near4 crosstalk$) and ink near1 jet)	USPAT; US-PGPUB	2003/08/22 11:27
25	63	(347/$.ccls. and (electrode or channel) near4 crosstalk$) not ((347/$.ccls. and (electrode or channel) near4 crosstalk$) not ((347/$.ccls. and (electrode or channel) near4 crosstalk$) and ink near1 jet))	USPAT; US-PGPUB	2003/08/22 11:27

L Number	Hits	Search Text	DB	Time stamp
1	904	347/40-42.ccls.	USPAT	2003/08/22 11:44
2	449	347/40-42.ccls. and (distance or spacing) near5 (nozzle or orifice or electrode or port or channel or resistor or heater)	USPAT	2003/08/22 11:45
3	20	347/40-42.ccls. and (distance or spacing) near5 (nozzle or orifice or electrode or port or channel or resistor or heater) same (crosstalk$ or interfer$)	USPAT	2003/08/22 11:48
4	78	347/40-42.ccls. and (distance or spacing) near5 (nozzle or orifice or electrode or port or channel or resistor or heater) and (crosstalk$ or interfer$)	USPAT	2003/08/22 11:48
5	58	(347/40-42.ccls. and (distance or spacing) near5 (nozzle or orifice or electrode or port or channel or resistor or heater) and (crosstalk$ or interfer$)) not (347/40-42.ccls. and (distance or spacing) near5 (nozzle or orifice or electrode or port or channel or resistor or heater) same (crosstalk$ or interfer$))	USPAT	2003/08/22 12:00
6	41	((347/40-42.ccls. and (distance or spacing) near5 (nozzle or orifice or electrode or port or channel or resistor or heater) and (crosstalk$ or interfer$)) not (347/40-42.ccls. and (distance or spacing) near5 (nozzle or orifice or electrode or port or channel or resistor or heater) same (crosstalk$ or interfer$))) and (dpi or mu.m or micron or micrometer or mm)	USPAT	2003/08/22 12:00

US-PAT-NO: 4069486

DOCUMENT-IDENTIFIER: US 4069486 A

TITLE: Single array ink jet printer

---------- KWIC ---------

Brief Summary Text - BSTX (10):

A more desirable solution would permit complete freedom on the center to center spacing of the nozzles which would allow a center to center nozzle spacing larger than the center to center spacing of the drops on the paper in the axial direction with negligible sacrifice of either printing speed or resolution. Such a solution would ease the fabrication of the nozzles and permit a much wider choice of existing nozzle technologies, such as glass drawn nozzle arrays or etched amorphous material arrays, all of which require substantial spacing. In addition, freedom of spacing minimizes problems in charge electrode packaging, guttering deflection systems and other problems related to electrical crosstalk are more readily solved.

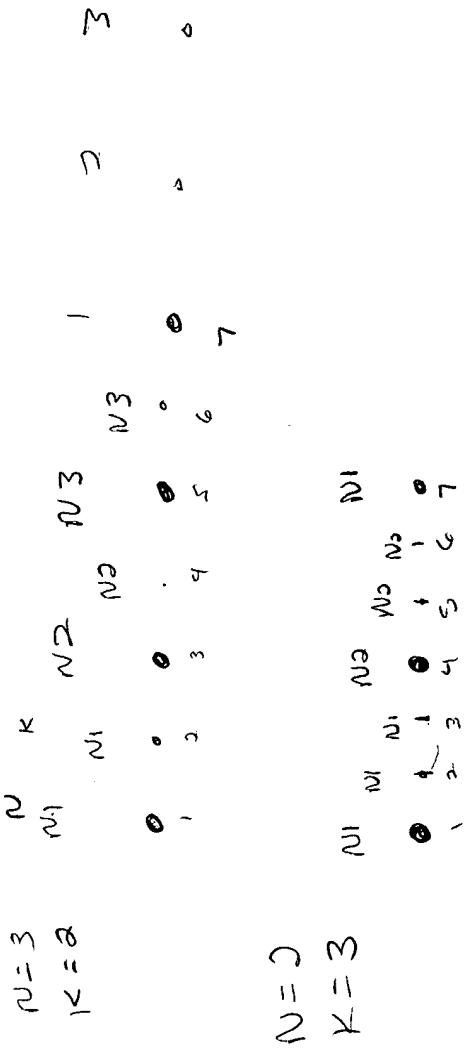
Current US Original Classification - CCOR (1):

347/41

Current US Cross Reference Classification - CCXR (2):

347/3

L Number	Hits	Search Text	DB	Time stamp
1	3	("6367912" or "6213585" or "6347862").pn.	USPAT; US-PGPUB	2003/08/22 09:41
2	3	(("6367912" or "6213585" or "6347862").pn.) and "150" near5 dpi	USPAT; US-PGPUB	2003/08/22 09:41
-	28273	347/$.ccls.	USPAT; US-PGPUB	2003/08/22 09:40
-	14838	347/$.ccls. and ink near1 jet	USPAT; US-PGPUB	2003/08/21 18:13
-	13435	347/$.ccls. not (347/$.ccls. and ink near1 jet)	USPAT; US-PGPUB	2003/08/21 18:14
-	14838	347/$.ccls. not (347/$.ccls. not (347/$.ccls. and ink near1 jet))	USPAT; US-PGPUB	2003/08/21 18:14
-	0	(347/$.ccls. not (347/$.ccls. not (347/$.ccls. and ink near1 jet))) and "150" near5 dpi	USPAT; US-PGPUB	2003/08/21 18:15
-	130	347/$.ccls. and "150" near5 dpi	USPAT; US-PGPUB	2003/08/21 18:50
-	3	ink near1 jet and "150" near5 dpi	EPO; JPO; DERWENT	2003/08/21 18:50



US-PAT-NO: 6367912

DOCUMENT-IDENTIFIER: US 6367912 B1

TITLE: Ink jet recording apparatus

---------- KWIC ---------

Detailed Description Text - DETX (8):
The orifice plates 45B, 45Y, 45M, and 45C are aligned in a direction shown by arrow R and are formed with orifices 22B1-22Bn, 22Y1-22Yn, 22M1-22Mn, and 22C1-22Cn therein, respectively. The Each orifice plate is formed with 54 orifices therein at intervals of P1=0.169 mm, providing a resolution of 150 DPI.

Current US Original Classification - CCOR (1):
347/43

Current US Cross Reference Classification - CCXR (1):
347/40

US-PAT-NO: 6213585

DOCUMENT-IDENTIFIER: US 6213585 B1

TITLE: Image formation apparatus

---------- KWIC ---------

Detailed Description Text - DETX (31):
FIG. 5 is a graph plotting evaluation amount by simulation at each of head moving step amounts T=1, 3, 5, and 7 when the image is formed with a resolution of 300 dpi by using a recording head having the ink jet-out ports 33a arranged at intervals of ~~150 dpi.~~ Curves g3, g4, g5 of the graph in the figure respectively show evaluation amounts in the cases three types of ink jet-out head different in size and shape of jet out ports are used.

Detailed Description Text - DETX (39):
In the aforementioned embodiments, we explained the case where the image is formed with resolutions of 300 dpi or 600 dpi by using the recording head having the ink jet out ports arranged at intervals of 150 dpi. The same explanation can be adopted to the cases where the image is formed with a resolution of 2A dpi or 4A dpi by the use of the recording head having ink jet out ports 33a arranged at intervals of A dpi.

Current US Original Classification - CCOR (1):
347/41

US-PAT-NO: 6347862

DOCUMENT-IDENTIFIER: US 6347862 B1
See image for Certificate of Correction

TITLE: Ink-jet head

---------- KWIC ---------

Detailed Description Text - DETX (28):
For example, in producing a nozzle head with a density of 150 dpi, the widths of compression chambers are usually set to 100 .mu.m and those of partition walls between each of the adjacent compression chambers to about 66 .mu.m. However, when the thickness of a PZT thin film is decreased to 5 .mu.m or less, it becomes possible enough to process the PZT thin film into film strips with a width of 50 .mu.m or less, so that it makes sure to process the piezoelectric film into shaped films having such a size that can correspond to a compression chamber with a width of 100 .mu.m. In this regard, there are difficulties in processing a conventional piezoelectric film with a thickness of 20 .mu.m or more into piezoelectric film strips with a width of 50 .mu.m. On the other hand, in the first embodiment, it is possible to process the piezoelectric film into film strips with a width of 20 .mu.m or less. Accordingly, it is also possible to provide a nozzle head having a density of 500 dpi or more depending on possible shapes and sizes of the processed piezoelectric films. FIG. 6 is a front view of a nozzle head having outlets (or nozzles) formed at a density of 200 dpi, provided by the above method.